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EPIDERMAL AND VENATION STUDIES IN APOCYNACEAE-IV

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ABSTRACT

Epidermal characters and venation pattern of the leaves of eight species of Apocynaceae, *viz. Adenium multiflorum* Klotzsch, *Allamanda violacea* Gardn., *Carissa grandiflora* A.DC., *Catharanthus pusillus* (Murr.) G. Don, *Ichnocarpus frutescens* R.Br., *Kopsia fruticosa* A.DC., *Strophanthus hispidus* DC., and *Trachelospermum jasminoides* Lem. have been studied.

INTRODUCTION

The present paper, in continuation with the authors' previous communications of the series (Chandra *et al.*, 1969, Kapoor *et al.*, 1969 and Sharma *et al.*, 1970), deals with epidermal features and venation pattern of eight more species of Apocynaceae. The species dealt with are *Adenium multiflorum* Klotzsch, *Allamanda violacea* Gardn., *Carissa grandiflora* A. DC., *Catharanthus pusillus* (Murr.) G. Don, *Ichnocarpus frutescens* R. Br., *Kopsia fruticosa* A. DC. and *Trachelospermum jasminoides* Lem. The previous publications in the series have described the epidermal characters and venation pattern of twenty five species of Apocynaceae.

MATERIAL AND METHODS

Normal and mature leaves were collected from the plants growing in the National Botanic Gardens, Lucknow, in the months of August and September. The same methods as described earlier (Chandra *et al.*, loc. cit.) were followed. However, the material of *Ichnocarpus frutescens* and *Trachelospermum jasminoides* could not be cleared with chloral hydrate and was consequently treated with concentrated nitric acid for five minutes.

OBSERVATIONS

Adenium multiflorum Klotzsch

Macro-characters: Leaves subsessile, petioles, 0.2-0.4 cm long, obovate or obovate-elliptic, obtuse or retuse, base narrowed into the petiole 3.5-9 cm × 1.5-6.5 cm, entire, subcoriaceous, dark green and shining above, pale green and dull beneath, glabrous on both the surfaces, veins faint, midrib thin but slightly raised beneath, lateral veins very oblique, arched, nervation not conspicuous.

Micro-characters: Epidermal cells on lower surface pentagonal or hexagonal or polygonal, straight walled, 25-38-50-63 × 13-20-25-38 μ striated, striations mostly radiating prominently from relatively bigger size stomata or may be parallel to stomatal axis, cells filled with globules; on upper surface mostly hexagonal, straight walled, 68-75-88-113 × 25-38-50-63 μ, rosette crystals present. Stomata confined to lower surface, 25-30-38 × 18-20-25 μ, commonly cyclocytic or ranunculaceous or rubiaceous, stomatal index 11-11.5-13.5. Trichomes absent. Vein islets 1-2-4 per sq. mm, at times not even a single islet covered by a unit area; vein endings 10-15-21 per sq. mm. Palisade ratio 10-11-13.

Allamanda violacea Gardn.

Macro-characters: Leaves verticillate, usually in whorls of 4, occasionally 3-whorled, almost sessile, narrowly elliptic or somewhat oblanceolate or oblanceolate-elliptic, may be shortly caudate, acute, base cuneate or somewhat rounded, 6.5-9.5 cm (reported to be 10-15.5 cm) × 2-3 cm, entire, thinly coriaceous, dull green above, whitish green below, hispidly hairy on both the surfaces, main lateral veins 9-15 pairs, more or less parallel, arched near the margin, united into an intramarginal nerve, only midrib prominently raised beneath, nervation not conspicuous.

Micro-characters: Epidermal cells on lower surface slightly sinuous or straight-walled, 20-50-75-100 × 18-25-38-50 μ, prismatic crystals present, on upper surface polygonal, straight walled or slightly sinuous, 38-63-75-88 × 18-25-38-50 μ, filled with oil globules. Stomata confined to lower surface, 15-25-38-45 × 10-20-25-28μ, ranunculaceous or rubiaceous or cruciferous, stomatal index 13-15.6-16.7. Trichomes (Fig. 1) uniseriate, thick-walled, lignified, ends tapering, with flattened base, 130-400-600-850 × 10-20-30-60μ. Vein islets 5-6-8 per sq. mm ; vein endings 9-13-18 per sq. mm. Palisade ratio 8-9-10.

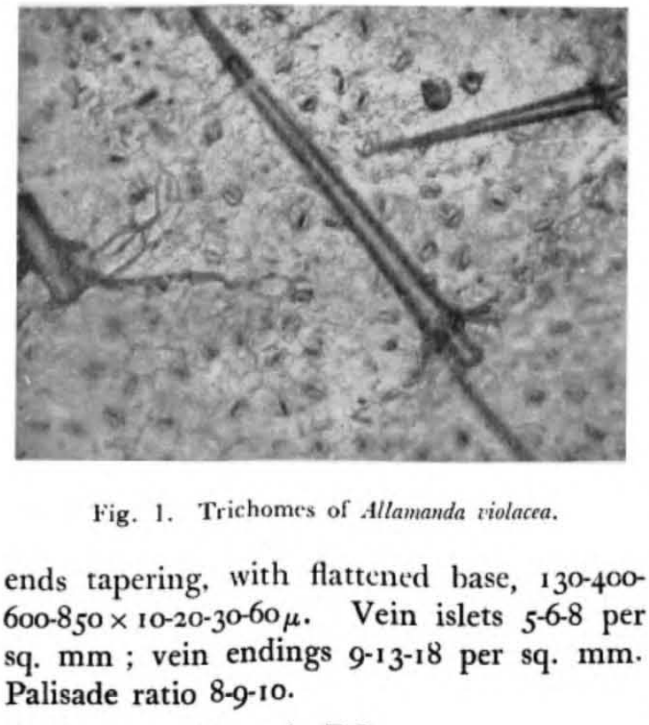


Fig. 1. Trichomes of *Allamanda violacea*.

Carissa grandiflora A. DC.

Macro-characters: Leaves opposite, shortly petiolate, petioles up to 0.5 cm long, glabrous, lamina ovate or elliptic, abruptly acuminate, tip spinascent, base rounded or subacute, faintly decurrent, 2-4.5 cm × 1.3-3.3 cm, entire, coriaceous, dark green above, pale green beneath, glabrous on both the surfaces, midrib slightly raised beneath, nervation not conspicuous.

Micro-characters: Epidermal cells on lower surface straight walled, hexagonal or elongated or more or less square, 18-25-38-50 × 10-13-20-25 μ; on upper surface hexagonal, straight walled, 20-38-50-63 × 18-20-25-38 μ, striated. Stomata mostly rubiaceous or cyclocytic, 25-30-38-45 × 20-25-30-38 μ, stomatal index 12-14-15.4. Vein islets 6-9-12 per sq. mm ; vein endings 3-5-7 per sq. mm. Palisade ratio 5.

Catharanthus pusillus (Murr.) G. Don

Macro-characters: Leaves opposite, shortly petiolate, petioles up to 0.7 cm long, glabrous, lamina lanceolate, shortly caudate-acuminate or -acute, base cuneate, faintly decurrent, 3.5-8.0 cm × 0.8-2.5 cm, entire, membranous, bright green above, lighter beneath, more or less glabrous on both the surfaces, margins minutely scabrid, lateral veins and midrib may also be sparsely minutely scabrid, only midrib and main lateral veins prominent beneath, main lateral veins 6-10 pairs, nearly parallel, nervation not conspicuous.

Micro-characters: Epidermal cells on lower surface deeply sinuous, 30-50-63-100 × 18-25-38-50μ ; on upper surface straight walled or slightly sinuous, 25-63-75-88 × 25-38-45-50μ faintly striated, striations parallel to one or more walls of epidermal cells. Stomata cruciferous or ranunculaceous or occasionally actinocytic, on lower surface 25-30-38-68 × 13-15-18-20 μ, stomatal index 20-20.5-22.2, on upper surface 20-25-38-68 × 13-15-20-25μ, twin stomata observed on upper surface, stomatal index 16.6-17-19.4. Vein islets 6-8-11 per sq. mm ; vein endings 1-3-4 per sq. mm. Palisade ratio 5-6-7.

Ichnocarpus frutescens R. Br.

Macro-characters: Leaves opposite, petiolate, petioles up to 0.7 cm long, lamina elliptic or elliptic-oblong or broadly lanceolate, acute or acuminate, base usually rounded, 4.5-8 cm × 1.9-3.9 cm, entire, thinly coriaceous, dark green above, pale green beneath villo-pubescent or ultimately glabrescent above, more or less softly tomentose or glabrescent beneath, main lateral veins 5-7 pairs, distantly placed, with fine reticulate venation in between, nervation conspicuous.

Micro-characters: Epidermal cell on lower surface straight walled, penta- or hexagonal, 10-20-25-38 × 8-13-20-25 μ, slightly striated, cells filled with globules; on upper surface polygonal, straight walled, 15-25-28-50 × 13-15-20-25μ, filled with oil globules. Stomata confined to lower surface, 10-18-25-30 × 8-13-18-25μ, rubiaceous, stomatal index 13-15.6-16.7. Trichomes (Fig. 2) non-glandular uniseriate with pointed ends, thin walled, with multi-cellular base, 80-300-550-800 × 10-20-30μ.

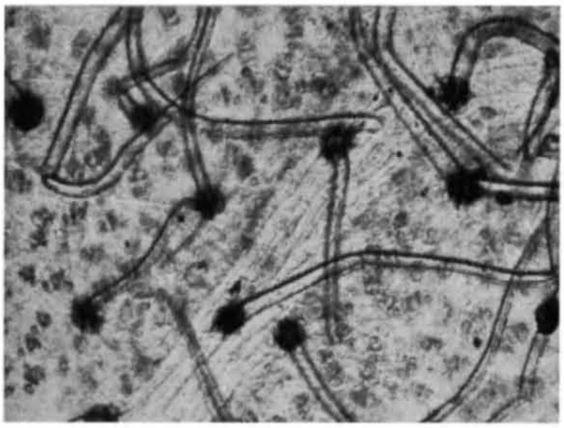


Fig. 2. Trichomes of *Ichnocarpus frutescens.*

Vein islets 17-20-24 per sq. mm; vein endings 8-12-17 per sq. mm. Palisade ratio 6-7.

Kopsia fruticosa A. DC.

Macro-characters: Leaves opposite, shortly petiolate, petioles up to 0.3 cm long, stout, lamina elliptic or elliptic-lanceolate or oblong-elliptic, obtusely caudate, tips drying off, base narrowed into the short petiole, 8-21 cm × 3.5-9.5 cm, entire, thinly coriaceous shining light green above, paler beneath, green when dry, glabrous on both the surfaces, main lateral veins 10-15 pairs, slightly arched, reticulations distinct on the lower surface.

Micro-characters: Epidermal cells on lower surface straight walled or slightly sinuous, tetra- to hexagonal, 15-20-25-56 × 8-13-15-25μ; on upper surface polygonal, straight walled, 15-25-30-38 × 13-15-18-20μ, starch grains and rosette crystals of calcium oxalate present. Stomata confined to lower surface, 13-20-25 × 10-15-20μ, rubiaceous or at times cyclocytic (Fig. 3), twin stomata observed, stomatal index 14-16.7-18. Vein islets 15-19-22 per sq. mm; vein endings 5-8-9 per sq. mm. Palisade ratio 3.

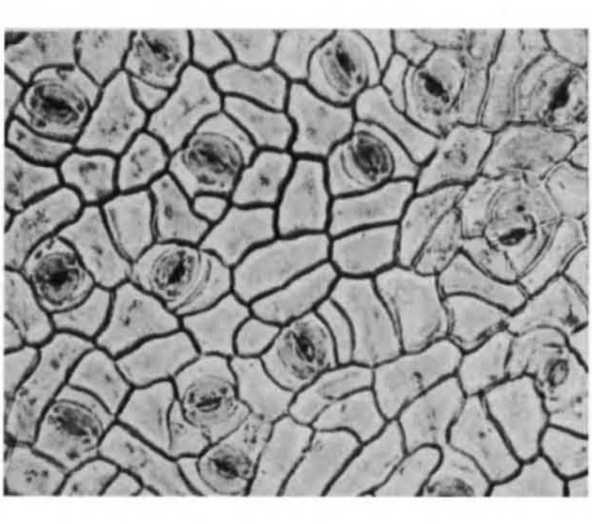


Fig. 3. Stomata of *Kopsia fruticosa.*

Strophanthus hispidus DC.

Macro-characters: Leaves opposite, shortly petiolate, petioles up to 0.5 cm long, glabrous, lamina oblong or elliptic-oblong, shortly and abruptly caudate-acute, base cuneate, slightly decurrent, 7-15 cm × 3-6.5 cm, entire, thinly coriaceous, smooth, shining green above, pale green beneath, glabrous on both the surfaces, midrib prominently raised beneath, main lateral veins 5-8 pairs, arched, these and tertiaries slightly raised, nervation more or less conspicuous.

Micro-characters: Epidermal cells on lower surface sinuous walled, 20-30-50-63 × 10-15-20-33μ, filled with globules; on upper surface hexagonal, straight walled, 20-25-38-45 × 13-20-25-30μ, faintly striated, rosette crystals of calcium oxalate present. Stomata confined to lower surface, 20-25-30-36 × 10-13-15-20 μ, rubiaceous, stomatal index 13-16-16.7. Vein islets 5-6-7 per sq. mm; vein endings 8-12-18 per sq. mm. Palisade ratio 6-7-8.

Trachelospermum jasminoides Lem.

Macro-characters: Leaves opposite, shortly petiolate, petioles up to 0.5 cm long, softly hairy, lamina elliptic or elliptic-lanceolate or ovate-lanceolate, acute or acuminate, base cuneate, faintly decurrent, 3-5.5 cm × 1.5-3 cm, entire, thinly coriaceous, dark shining green above, paler beneath, glabrous on both the surfaces, midrib, veins and veinlets only slightly raised beneath, main lateral veins 8-12 pairs, parallel, nervation not conspicuous.

Micro-characters: Epidermal cells on lower surface straight walled or slightly sinuous, tetra- to heptagonal, 15-20-30-38 × 8-10-15-20 μ; on upper surface polygonal, straight walled, 18-25-30-38 × 13-15-20-25 μ. Stomata confined to lower surface, 13-20-30 × 8-13-20 μ, ranunculaceous or rubiaceous, stomata with single guard cell observed, stomatal index 14-16.6-17.5. Trichomes are non glandular, thick walled, lignified with pointed ends, 70-200-300-350 × 10-20 μ. Vein islets 1-2-3 per sq. mm; vein endings 21-25-32 per sq. mm. Palisade ratio 5.

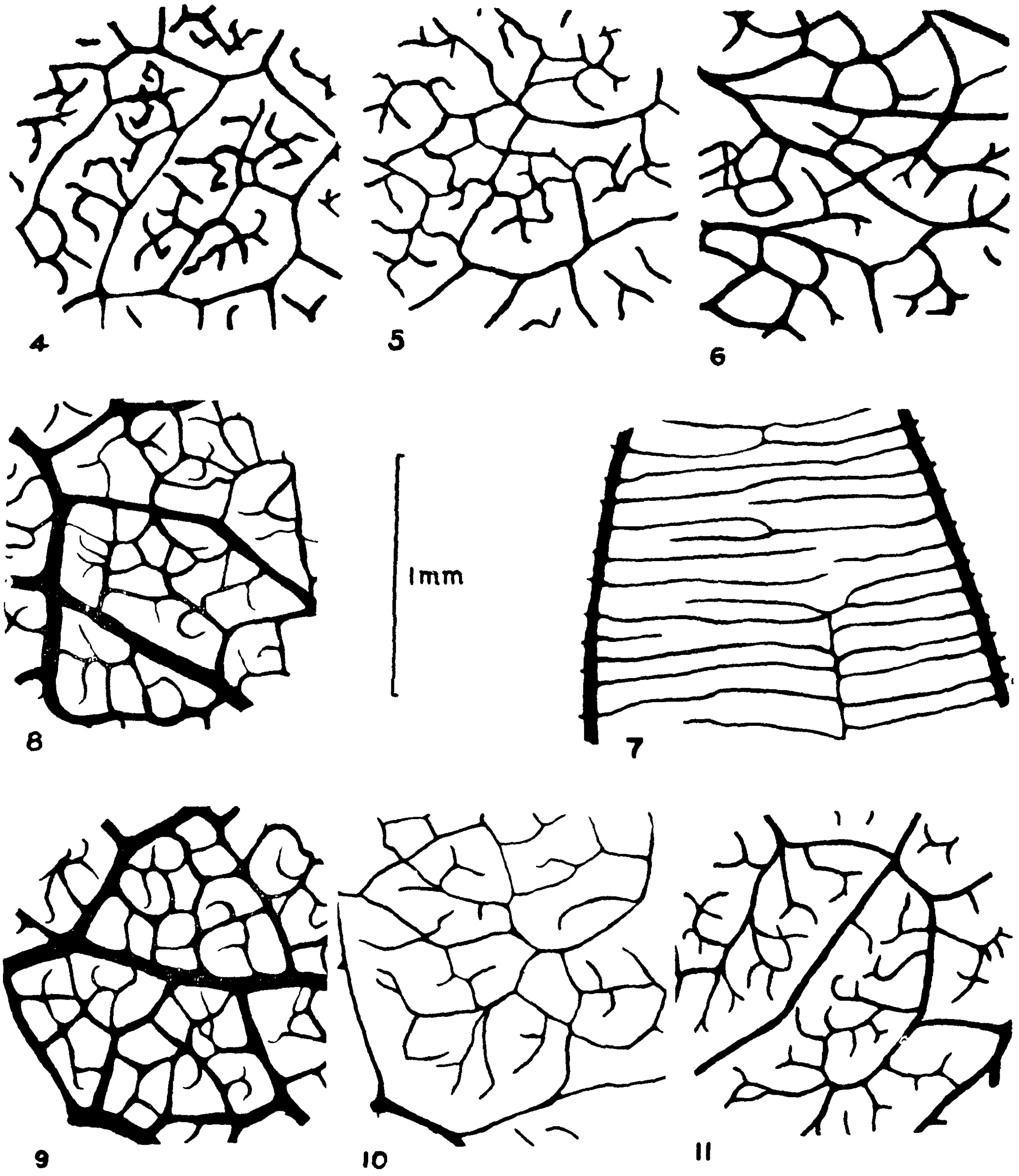
DISCUSSION

The important data regarding the present study are summarised in Table (*see* page 81).

In the species studied here, the epidermal cells if straight walled are mostly penta- or hexa-gonal as has been the case with the species already investigated (Chandra, *et al.*; Kapoor, *et al.* and Sharma, *et al.*, loc. cit.). The upper epidermal cells are straight or almost straight walled in all the present eight species; in addition, it may be slightly sinuous walled in *Allamanda violacea* and *Catharanthus pusillus*. The lower epidermal cells are sinuous walled in *Catharanthus pusillus* and *Strophanthus hispidus*, slightly sinuous walled in *Trachelospermum jasminoides* and straight walled in the remaining species; it may also be at times sinuous walled in *Allamanda violacea* and *Kopsia fruticosa*.

Stomata are absent on upper surface except in case of *Catharanthus pusillus*. Stomata are mostly rubiaceous except in *Catharanthus pusillus* in which no rubiaceous stomata were seen. In *Adenium multiflorum*, *Allamanda violacea*, *Catharanthus pusillus* and *Trachelospermum jasminoides* ranunculaceous ones have also been observed. In *Allamanda violacea* and *Catharanthus pusillus* cruciferous stomata have been observed; in *Adenium multiflorum*, *Carissa grandiflora* and *Kopsia fruticosa* cyclocytic type have been noted too and in *Catharanthus pusillus* actinocytic have been seen along with other types. Stomatal index in the upper surface in case of *Catharanthus pusillus* is 16-17-19 but Chaudhuri (1963) has reported it to be 6-8. On the lower epidermis stomatal index is highest in *Catharanthus pusillus*.

Venation patterns of the different species are illustrated in Fig. 4 to 11. *Catharanthus pusillus* is characteristic in having narrow elongated islets, like those of *Catharanthus roseus*. The number of vein islets per sq. mm varies from species to species. The highest figure of 25 is recorded in *Trachelospermum jasminoides* followed by *Ichnocarpus frutescens* and *Kopsia fruticosa* which have the figure of 20 and 19 respectively. The corresponding figure is characteristically low (2 only) in *Adenium multiflorum*. Similarly the number of vein endings per sq. mm vary from species to species. The lowest figures of 2 and 3 are characteristic of *Trachelospermum jasminoides* and *Catharanthus pusillus* respectively. *Adenium multiflorum* shows the highest vein ending number per sq. mm (15) closely followed by *Allamanda violacea* (13) and *Ichnocarpus frutescens* and *Strophanthus hispidus* (both 12). *Adenium multiflorum* is distinguishable with other species with its highest palisade ratio. *Kopsia fruticosa* has the lowest palisade ratio.



Figs. 4-11. Venation pattern : 4. *Adenium multiflorum* ; 5. *Allamanda violacea* ; 6. *Carissa grandiflora* ; 7. *Catharanthus pusillus* ; 8. *Ichnocarpus frutescens* ; 9. *Kopsia fruticosa* ; 10. *Strophanthus hispidus* ; 11. *Trachelospermum jasminoides*.

TABLE

S.No. Name of species	STOMATA					EPIDERMAL CELL				VENATION		
	Type	Size in μ (average)		Stomatal Index		Cell Wall		Cell size in μ (average)		Vein islets per sq. mm. (average)	Vein endings per sq. mm. (average)	Palisade ratio (average)
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper			
1. *Adenium multiflorum* Klotzsch	Cy; Ra; Ru	30×20	Absent	11-11.5-13.5	—	Straight	Straight	38-50 × 20-25	75-88 × 38-50	2	15	11
2. *Allamanda violacea* Gardn.	Ra; Ru; Cr	38×20	Absent	13-15.6-16.7	—	Slightly sinuous or straight	Straight or slightly sinuous	50-75 × 25-38	63-75 × 38	6	13	9
3. *Carissa grandiflora* A.DC.	Ru; Cy.	38×25	Absent	12-14-15.4	—	Straight	Straight	25-38 × 13-20	38-50 × 20-25	9	5	5
4. *Catharanthus pusillus* (Murr.) G.Don	Cr; Ra; Occ.Ac.	30×15	25×20	20-20.5-22.2	16.6-17-19.4	Sinuous	Straight or slightly sinuous	50-63 × 25-38	63-75 × 38-45	8	3	6
5. *Ichnocarpus frutescens* R.Br.	Ru	25×13	Absent	13-15.6-16.7	—	Straight	Straight	20-25 × 13-20	25-38 × 15-20	20	12	6
6. *Kopsia fruticosa* A.DC.	Ru; Occ. Cy.	20×15	Absent	14-16.7-18	—	Straight or slightly sinuous	Straight	20-25 × 13-15	25-30 × 15-18	19	8	3
7. *Strophanthus hispidus* DC.	Ru	25×13	Absent	13-16-16.7	—	Sinuous	Straight	30-50 × 15-20	25-38 × 20-25	6	12	7
8. *Trachelospermum jasminoides* Lem.	Ra; Ru	20×13	Absent	14-16.6-17.5	—	Slightly sinuous	Straight	20-30 × 10-15	25-30 × 15-20	25	2	5

Ra, ranunculaceous ; Ru, rubiaceous ; Cr, cruciferous ; Cy, cyclocytic ; Ac, actinocytic.

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